

# CRM

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## Aircraft As Cultural Resources The Indiana Approach

Paul C. Diebold

**H**istoric preservation, by its very nature, focuses on fixed, concrete resources. In the past decades, both the private and public sectors of the preservation community in the United States have become familiar with the documentation and preservation of many types of historic buildings and structures. Fragile and everchanging resources such as vernacular and designed landscapes are being inventoried and nominated to the National Register of Historic Places. Yet, with all our experience, the preservation community has had very little contact with the aviation community. No official, agreed upon standards for the evaluation and registration of aircraft exist, not to mention standards for restoration, or even uniform definitions for aircraft preservation terminology.<sup>1</sup> Can standard historic preservation procedures for survey and registration be applied to historic aircraft? The Indiana Division of Historic Preservation and Archaeology recently inaugurated a historic aircraft inventory and nomination program, culminating in the nomination of a B-17 bomber to the National Register of Historic Places. SHPOs or private non-profits interested in pursuing similar programs may benefit from both the successes and pitfalls encountered by the Indiana program.

(*Aircraft*—continued on page 3)



Cultural Resource Management  
Information for  
Parks, Federal Agencies,  
Indian Tribes, States, Local  
Governments and the  
Private Sector



U.S. Department of the Interior  
National Park Service  
Cultural Resources

Above: Boeing B-17G "Flying Fortress" No. 44-83690 was produced in 1945. The "G" model was the final and most sophisticated version of the B-17, distinguished by the twin-gunned "chin" turret. After nearly a decade of use in missile and nuclear weapons evaluation, 44-83690 was flown to Grissom AFB (then known as Bunker Hill AFB) in 1961 for static display. Visitors may see the plane without entering the base itself. Photo by Paul Diebold. Top Left: North American SNJ-5 N62724 soars over the cornfields of southern Indiana. A variant of the venerated AT-6 "Texan," this SNJ-5

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### Supplement

#### Oral History

Send articles, news items, and correspondence to the Editor, CRM (400), U.S. Department of the Interior, National Park Service, Cultural Resources, P.O. Box 37127, Washington, DC 20013-7127; (202-343-3395).

# Aircraft as Cultural Resources

(continued from page 1)

Preservationists should be familiar with the nature of aircraft and aviation history before approaching them as historic resources. Aviation is a young, forward-looking science. Its emphasis is on new technology and safety issues. Unlike the maritime community, which has developed a respect for the past and deeply ingrained traditions, aviation has only recently begun to appreciate its roots. Indeed, interest in historic aircraft has grown dramatically in the past 20 years. The Smithsonian's Air and Space Museum is among the nation's most visited museums, and thousands flock to air shows to witness the thrill of authentic historic aircraft in operation. This unprecedented interest in aircraft sometimes has ironic results; the Alaska SHPO, for example, is under constant pressure to allow artifact recovery on its National Register-listed World War II aircraft crash sites, so that the spare parts can keep other warbirds airworthy.

Aircraft themselves are dissimilar to the majority of resources preservationists encounter. A plane is a mass-produced machine intended to safely transport people and cargo. Operating an aircraft means change. Interchangeable parts allow mechanisms to be replaced often. Engines are overhauled or replaced to insure safety standards are maintained. Fragile historic materials, such as canvas wing or fuselage coverings, can now be replaced with stronger synthetic fabrics. Granted the fragile nature of aircraft, and the facts of operating an aircraft over an extended period of time, evaluation of historic aircraft for integrity and significance is challenging.

## Survey

The first step in Indiana's program was to produce an inventory of historic aircraft. Without benefit of Sanborn maps or atlases, the problem of mere identification seemed problematic. One could obtain a list of active airfields, and simply canvas each field for historic aircraft. While this might produce good results, it is labor intensive. With no additional staff available, and time at a premium, a less labor-intensive approach was needed. In Indiana, any aircraft, airworthy or not, must be registered

with the Indiana Department of Transportation (INDOT) for tax purposes. With the cooperation of INDOT, the Division was able to obtain a list of all aircraft based in Indiana built prior to 1946. The most pertinent information was determined to be 1) civilian or military registration number, 2) make and model, 3) year of construction, 4) airworthy status, and 5) owner's name and address. Aviation museums and interested private non-profit groups, such as the local wing of the Confederate Air Force, put staff in direct contact with some aircraft missed by the computer check. Armed with this information, and a working knowledge of both civilian and military aircraft, staff waded through the data to locate planes which seemed to warrant further investigation. The decision to investigate was based on 1) significance of the type of aircraft, 2) rarity of the type of aircraft, and 3) airworthy status (hoping that airworthy planes would be better maintained and have greater owner interest and pride). Since staff time was limited, a letter was sent to these selected owners. Each letter requested a photograph, and detailed information about the use of the plane.<sup>2</sup> Using these relatively labor-free techniques, the Division was able to produce an inventory of historic aircraft somewhat comparable to its historic building inventory. Over 200 historic aircraft were located by the survey.



WACO UPF-7 NC 32080 is based in a small central Indiana airfield. Built in 1941, it shows a typical WACO design. Tubular metal struts and interior eliminated the need for elaborate cross bracing wires seen on earlier biplanes. Photo by Jerry Brown.

About 100 requests were sent to specific owners, of which about 35 responses were received by the Division. In retrospect, the Division would have received more responses if better ties to the aviation community would have been established, perhaps through bulletins distributed to airfields, or other "PR" activities. If time would have allowed, arranging for inspections of all 200 aircraft would have been ideal,

and would have provided more reliable data.

In general, owners who replied provided useful information about their planes and were cooperative. Types identified by the survey varied widely. Both civilian and military types have been located, and some, such as a handful of DC-3 aircraft, are still in commercial service. Most others are pampered toys, maintained solely for pleasure. Among the oldest type of aircraft based in Indiana is the WACO (pronounced wah-ko), manufactured in Troy, OH, from 1923 to 1947 by the Weaver Aircraft Company. Weaver was a small firm which sought to capitalize on the growing market for, and lack of, good aircraft available to the public shortly after

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World War I. WACOs were status symbols. They share classic design characteristics of the period: biplane configuration, bulky yet streamlined fuselages, and curved tail surfaces. During World War II, the WACO UPF-7 was designated P-14 and used as a trainer. At least one Indiana WACO is known to have been used as part of the Civilian Pilot Training program during World War II. About 300 WACOs of various types still exist in the U.S., 20 of these are Indiana-based.

The survey also revealed several planes which might have Hoosier origins. Several Republic P-47D “Thunderbolts” are now based in Indiana, not too distant from the Evansville, Indiana, Republic Aviation plant in which they were likely produced. (The factory, now a Whirlpool

appliance plant, still exists and was recorded in the Division’s historic building survey.) Like most World War II single seat fighters, “Thunderbolts” are rare birds.

### Nomination

The Division hopes to focus special attention on intact examples of World War II aircraft through registration. Indiana is home to about 50 aircraft of various types which were trainer or combat planes. As a test case, the Division took the opportunity to prepare a National Register nomination for B-17G “Flying Fortress” No. 44-83690. The aircraft is on static display at Grissom Air Force Base (near Peru, IN) and is



Significant design characteristics are often retained by military aircraft which never saw combat. North American P-51D 5NA “Mustang” No. 44-73436, for example, still retains its British designed Rolls-Royce “Merlin” power plant, as well as its “Laminar Flow” airfoil design. NACA (National Advisory Committee for Aeronautics, the precursor agency to NASA) scientists devised the airfoil which reduced drag by 50%, and the “Mustang” was the first practical application of this new airfoil type. This plane is based in northeast Indiana. Photo by Dean Cutshall.

federally owned, so permission needed to be secured from the U.S. Air Force officials and the Federal Preservation Officer. Evaluation of the aircraft’s National Register potential involved on-site inspection and research.

### Related Historic Properties

The Boeing B-17 bomber was a truly remarkable aircraft. It was a four engine bomber, designed in 1934, first tested in 1935, and in production by December 7, 1941. After America’s entry into World War II, the B-17 became the main aircraft used in American daylight bombing attacks on Germany until the end of the war. The history of this remarkable plane intersects with the history of several National Historic Landmarks and serves as a connecting link between these historic properties.

*The Variable Density Wind Tunnel, Langley, Virginia (1921).*

The success of the Wright Brothers airplane was followed by a technological backward slide by the American aircraft industry. British, French, and German designers soon surpassed the Wright Brothers and other American aircraft builders. By World War I the United States had slipped into a position of technological inferiority compared to the European designers.

To support their aircraft industry European designers built major wind tunnels to test new theories and to discover better methods of building aircraft. To regain for America the technological leadership in the field of aircraft design and manufacture, President Woodrow Wilson signed into law a bill establishing the National Advisory Committee for Aeronautics (NACA) March 3, 1915.

In June 1921 NACA’s Executive Committee decided to

leapfrog European wind tunnel technology and build a tunnel in which pressures could be varied. This concept was strongly advocated by Max Munk, a NACA technical assistant, who was familiar with European wind tunnel design from his days at Gottingen. The VDT, for the first time, placed in the hands of NACA engineers a research tool superior to that found anywhere else in the world. The VDT was able to predict flow characteristics of test aircraft models more accurately than any other tunnel then in existence. The VDT quickly established itself as a primary source for high quality aerodynamic data.

The result of this research led to the publication of NACA Technical Report 460 in which aerodynamic data for 78 related airfoil sections were presented. Information contained in this report eventually found its way into the design of the B-17 which quickly dominated the skies over Germany in World war II.

*Full Scale Tunnel, Langley, Virginia (1931).*

Although the Variable Density Tunnel gave NACA engineers confidence in scaling up test results from models, several research areas could be explored only with full-scale models or with actual aircraft. The VDT was limited when the aerodynamic characteristics of a complete airplane were desired because it was practically impossible to build a model of the required size that is a true reproduction of a complete airplane. This difficulty is increased by the requirement that the model withstand large forces.

## Evaluation

The significance of this aircraft type is well known. The B-17 is probably the most widely recognized American plane of World War II. Designed in response to a 1935 competition held by the Army Air Corps, the B-17 met the requirement of long range, high speed, and high altitude performance specified by the Corps. Its four engine design was unusual for its time, and its ability to absorb battle damage was legendary. Boeing engineers designed the B-17 so that adjacent ribs or stringers could provide support in the event of failure. This bomber type earned fame as the mainstay of the U.S. Army Air Force's "strategic daylight bombing" campaign in the European Theatre. Clearly, as a type, B-17s are historically significant.

Scott Thompson's *Final Cut*<sup>3</sup>, a recent publication which includes information about each existing B-17, proved to be an invaluable resource. The Division was able to use this publication essentially as a survey of existing B-17s. Nominators of historic aircraft should be aware that similar publications exist for other popular historic aircraft types. This publication allowed the Division to assess the relative integrity and significance of 44-83690.

Staff felt that evaluation for this property should be done at the national level, since it generally had no specific connection to one location. Also, military planes such as 44-83690 were part of a national defense plan.<sup>4</sup> Historical association can be problematic for existing World War II aircraft. Both veteran and new, never used, planes were scrapped by the thousands, while a few others were sold or used for a variety of military uses. No B-17s were made after 1945, but only three of the 50 existing B-17s saw actual combat during the war. For this rea-

son, it was felt that the plane was best evaluated for its importance as a representative example of a significant aircraft type and for its design characteristics under Criterion C. Further research about post war uses of B-17s brought important historical data to light. B-17s were used to evaluate new weapons systems during the late 1940s and 1950s. Manned B-17s were paired with drone (unmanned) B17s which were radio controlled from the manned plane. The drones were used as targets for America's new generation of missile weapons, including Nike, Bomarc, and Sidewinder systems. Testing helped perfect the Nike system, which became the nation's first line of defense against aircraft during the Cold War. Open nuclear tests also provided important research data in the 1950s and served as dramatic displays of American military might. Drone B17s were guided into nuclear blast clouds to measure radiation levels by remote means. 44-83690 was used in both capacities during the Cold War, and staff determined that enough contextual information existed to evaluate the plane for exceptional significance under Criterion A in the area of military history. The basis for evaluation of integrity used the seven standards used in National Register Bulletins 15 and 16A: location, design, setting, materials, workmanship, feeling, and association.<sup>5</sup> As preservationists are aware, these seven categories do not equally apply to all resources. In the case of historic aircraft, staff felt that the least important considerations were location, setting, feeling, and workmanship. Integrity of design was deemed most important. As a basic test of integrity, staff reasoned that any historic aircraft should A) have the majority of its airframe (the structure and skin of a plane, not inclusive of mechanical systems or power plant) and B) retain power plant(s) of the proper historic type. Retention of electrical

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Some of the questions that needed to be answered involved solving drag penalties due to external struts, surface gaps, air leaks, and engine cooling insulation. These questions could only be answered by using full-scale aircraft. Models simply would not work.

With funds appropriated before the start of the Depression, NACA was able to begin the building of a Full Scale Tunnel in 1929.

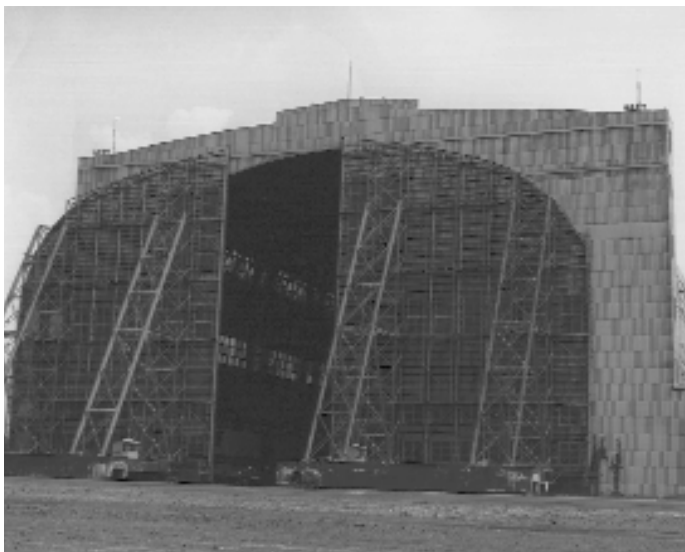
When completed in 1931, the significance of the Full Scale Tunnel was immediately apparent to NACA engineers. Drag tests in the tunnel indicated surprisingly large performance penalties from external struts and other exposed aircraft parts. This information had been suspected by NACA engineers for some time but with the completion of the Full Scale Tunnel the engineers now had the data needed to correct the problem. Soon a large procession of military aircraft, including the Boeing B-17, was dispatched to Langley for drag cleanup tests. Before and during World War II practically every high performance aircraft used by the United States was checked out at the Full Scale Tunnel. The tunnel operated 24 hours a day 7 days a week during the war performing drag cleanup tests for the military. For most of the war the Full Scale Tunnel was the only tunnel in the country and in the world capable of performing these tests. The importance of the tunnel was so evident that the United States built an even larger Full Scale Tunnel at the Ames Research Center in 1944.

*The Opana Radar Site, Hawaii (1941).*

In the early hours of the morning of December 7, 1941, two ordinary servicemen stationed at the Opana Radar Site in Hawaii used the new technology of radar to detect the approaching Japanese carrier aircraft. These men reported their findings to the temporary information center at Fort Shafter. Since this report came in after the designated watch time (4:00-7:00 a.m.), the information center staff had already gone to breakfast. The information officer had been on duty since 4:00 a.m., and this was only his second time at the Information Center. After receiving the Opana report, the information officer reasoned that the radar blip was a flight of Army B-17 bombers due in that morning. He therefore instructed the Opana Radar operations to disregard the information and "not to worry about it."

The Opana Station continued to plot the incoming Japanese planes until 7:40 a.m. when the contact was lost in the background interference as the planes approached Oahu. Both men then secured the Opana radar shortly before 8:00 a.m., and headed down the mountain for breakfast not realizing the implications of their discovery. The information officer was only partially correct. At 7:50 on the morning of December 7, 1941, a flight of Army B-17 aircraft did arrive at Pearl Harbor, only to be caught in the first wave of Japanese attack aircraft. America's preeminent bomber was now at war.

—Harry A. Butowsky



West end of Hangar No. 1, Naval Air Station, Lakehurst, NJ, August, 1969.  
Photo courtesy R.A. Hayes, U.S. Navy.

wishes to control these efforts and see that all due consideration is given to archeological research, care for potential human remains, and continued federal ownership of submerged aircraft.

The second element of the aviation CRM program is the National Register Bulletin, *Nominating Historic Aircraft and Aviation Facilities to the National Register of Historic Places*. Dr. Ann Millbrooke, an aviation historian and specialist in the history of the technology of flight, is researching, writing, gathering illustrations, and preparing this bulletin planned for publication in 1995.

The bulletin will provide the military services as well as the aviation and preservation communities with a guideline for evaluating the significance and integrity of historic aircraft and aviation facilities. This guideline is crucial to the evaluation of aviation properties within the national preservation context.

The third element is the *Naval Aviation Heritage National Historic Landmark Theme Study*. The Aviation Historical Branch of the Naval Historical Center is working with NPS to prepare a NHL theme study describing the development of U.S. naval aviation as illustrated by its surviving facilities, aircraft, and archeological sites. The theme study will include nominations of 12 to 15 properties of different types, including individual fixed wing, lighter than air, seaplane or rotary wing aircraft, crash sites, aviation support vessels, factories, airfields, testing centers and laboratories.

The study will serve as the basic framework for production of other NHL and National Register of Historic Places nominations for aviation. Sample nominations will provide a casebook on which to base future studies and can serve as a model for similar studies for other military services.

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**(Aircraft—continued from page 5)**

systems, armament, and other features may add to integrity of feeling.

After evaluation, staff agreed that B-17G 44-83690 met Criteria A and C, and that exceptional significance under criterion consideration G (less than 50 years of age) was justifiable for both the date of construction (1945) and for the plane's testing role (1951, and 1956-59). Presentation of this documentation in the nomination form followed the usual format, except that the description section was broken down into a specifications format. For example, the fuselage, wingspan and airfoil type, tail assembly, and performance characteristics were described by measurements and in writing. A separate paragraph described modifications and restoration activities, and the conclusion analyzed integrity using the seven National Register aspects of integrity. The statement of significance explained the importance of this aircraft type, and detailed how 44-83690 in particular was a good representative of this now rare type.

With acceptance of B-17G No. 44-83690 to the National Register of Historic Places on June 29, 1993, the Division's historic aircraft program came to fruition. The Division hopes that this nomination will serve as a model format for the nomination of other historically significant aircraft in Indiana, and in other states as well.

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<sup>1</sup> Although no agreed-upon standards exist, TIGHAR (The International Group for Historic Aircraft Recovery), 2812 Fawkes Dr., Wilmington, DE 19808, has published a *Guide to Aviation Historic Preservation Terminology*. Developments in maritime preservation can be applicable to aviation; the National Park Service National Maritime Initiative has published *The Secretary of the Interior's Standards for Historic Vessel Preservation Projects* (July, 1990) and National Register Bulletin 20: *Nominating Historic Vessels and Shipwrecks to the National Register of Historic Places* (James P. Delgado and a National Park Service Maritime Task Force, 1985). Currently, the National Park Service is preparing a National Register Bulletin, *Nominating Aircraft and Aviation Facilities to the National Register of Historic Places*.

<sup>2</sup> Flight logs are required to be maintained by the owner. Logs include flight and maintenance data, and have been mandatory since early aviation history. Copies of logs for military craft are maintained at central locations depending on the branch (Air Force, Navy, Marines) which used the plane.

<sup>3</sup> Scott A. Thompson, *Final Cut: The Post-War B-17 Flying Fortress: The Survivors*; Pictorial Histories Publishing Co., Missoula Montana, 1990.

<sup>4</sup> In some cases, nominations of aircraft for State or local significance may be appropriate. The Pilgrim 100 B aircraft in Dillingham, AK, for example, was listed on the National Register for its historic role in the development of aviation in Alaska. Pilgrim aircraft were a favorite among Alaskan bush pilots and "served as the workhorse of Alaskan aviation in the late 1930s and early 1940s."

<sup>5</sup> National Register Bulletin 15: *How to Apply the National Register Criteria for Evaluation* and National Register Bulletin 16A: *How to Complete the National Register Registration Form*.

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